Mikro II, lecture 3c

Moral hazard in the credit market

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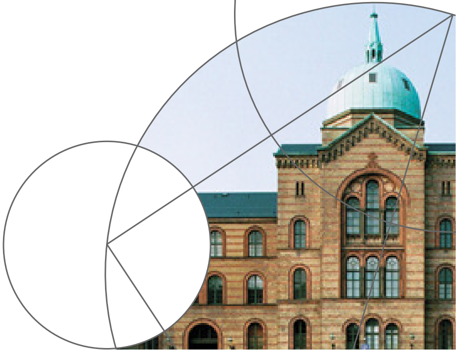

Plan for the lecture

1. Principal Agent model about moral hazard in the money lending market
2. Credit rationing
3. Competition and more principals in the Principal Agent model

Moral hazard in loan markets

- We end the topic of moral hazard with a look at loan markets

- Motivation:
  - Moral hazard in loan markets can help explain why people sometimes are refused a loan (credit rationing)

  - Basic economics puzzle: If you are willing to pay a hefty high interest rate, then there should always be someone who is willing to lend you money ... right?

The agent would like to open a bar

- The agent is now an entrepreneur who needs to borrow I to open a beer bar

- The agent can choose between opening two different types of beer bars, $i = a, b$:
  - Type a serves American Pale Ale (a.p.a.); with probability π_a that it becomes a success and gives payoff G_a, otherwise it goes bankrupt and gives a payoff of 0.

  - Type b serves Imperial Banana Stout (very $b$lack beer); with probability π_b it becomes a success and gives payoff G_b, otherwise it goes bankrupt and gives a payoff of 0.

The two types of bars

- Most beer drinkers like Pale Ale, so bar a is more likely to be successful: $\pi_a > \pi_b$
- Stout is a niche beer that connoisseurs will pay a lot for, so b has a higher potential payoff: $G_b > G_a$
- Overall, bar a is, however, the one with the highest expected payoff: $\pi_a G_a > \pi_b G_b$
- Note: Bar a is the socially efficient choice as long as we are not *risk-lovers* (a has less risk *and* greater expected value)

The principal is the bank

- The principal is a bank that offers a loan contract that maximizes the bank's profits (Sloth talks about a Venture Capitalist instead)

- The loan amount is always I (what the agent needs)

- The main element of the contract is how much to pay back R

- (We could have equivalently said that the main element of the contract was the interest rate r, but it is more convenient to look at the total payment $R = I(1+r)$)

Bankruptcy and profit

- If the agent borrows and the bar becomes a success, the agent pays back R and retains the rest of his payoff

- If the agent borrows and the bar goes bankrupt, all money is lost, so the bank gets nothing and the agent gets nothing either (i.e. limited liability: the bank cannot take the agent's house)

- We assume both agent and bank maximize expected profits; if bar a is selected, the expected profits of the agent and of the bank are:

$$\pi_a \cdot (G_a - R) + (1-\pi_a) \cdot 0 \qquad \text{and} \qquad \pi_a \cdot (R - I) + (1-\pi_a) \cdot (-I) = \pi_a R - I$$

Project choice and the contract

- We start by assuming that the bank can control what kind of beer is sold at the bar, i.e. the bank may require what type of bar is opened
- As before, we will first assume that the bank requires type a and find the optimal contract and then do the same for b
- Finally, we can compare the profits from the two contracts to see which project the bank will choose to require
- (In practice, it is not unusual for a lender to interfere in the business model before a business loan is granted)

The principal's problem, bar a

- Profit for both parties is shown on the previous slide and we note that the agent gets 0 profit if he says no to the loan (he does not open a bar at all):

$$\max_{R} \quad \pi_a \cdot R - I$$

$$\text{s.t.}$$

$$\pi_a \cdot (G_a - R) \geq 0 \qquad (\text{IR}_a)$$

- (IR_a) binds obviously (otherwise raise R) so we can easily solve for the optimal R^a:

$$\pi_a \cdot (G_a - R^a) = 0 \iff G_a - R^a = 0 \iff R^a = G_a$$

The principal's problem, bar b

- The problem is completely analogous if bar b is required instead ...

$$\max_{R} \quad \pi_b \cdot R - I$$

$$\text{s.t.}$$

$$\pi_b \cdot (G_b - R) \geq 0 \qquad (\text{IR}_b)$$

- ... and can be solved just as easily because (IR_b) binds:

$$\pi_b \cdot \left(G_b - R^b\right) = 0 \iff G_b - R^b = 0 \iff R^b = G_b$$

Optimal contract

- In both cases, the bank sets the repayment such that it gets the full payoff from the project if successful

- The very attractive terms for the bank are due to the fact that the agent's outside option is nothing and the bank designs the contract (take-it-or-leave-it)

- Compare bank's expected profit from claiming bar a vs. b:

$$\pi_a \cdot R^a - I = \pi_a \cdot G^a - I \qquad \text{vs.} \qquad \pi_b \cdot R^b - I = \pi_b \cdot G^b - I$$

- we have assumed that project a has the highest expected profit ($\pi_a \cdot G^a > \pi_b \cdot G^b$) so the bank will demand bar a; note that this is efficient (as usual)

Socrative quiz question

Under which conditions might the equilibrium contract feature bar b?

- a) If the principal is not risk-neutral but risk-averse.
- b) If the agent is not risk-neutral but risk-averse.
- c) If the principal is not risk-neutral but risk-loving.

Moral hazard: Choice of project is not part of the contract

- Now suppose the bank cannot observe what kind of beer is served (for example, because it is too expensive to check the beer taps every day)

- The bank can now no longer demand the opening of a specific bar in the contract; moral hazard: after receiving the loan, the agent can choose a different project than what the bank wants

- The bank again has two options:
  - Offer a contract based on the choice of bar a and design the contract such that this happens
  - Offer a contract based on the choice of bar b and design the contract such that this happens

Incentive Compatibility, bar a

- Let's look at what happens if the bank still wants bar a to be selected

- In that case, the contract must be designed such that the agent gets the highest expected profit by choosing a, giving the new IC$_a$ condition:

$$\pi_a \cdot (G_a - R) \geq \pi_b \cdot (G_b - R)$$

- Notice that this IC will bind: The old optimal contract with $R = G_a$ does not comply with IC$_a$

$$\pi_a \cdot (G_a - G_a) = 0$$

$$\pi_b \cdot (G_b - G_a) > 0$$

Problem with moral hazard, bar a (I)

- The principal's problem is:

$$\max_{R} \quad \pi_a \cdot R - I$$

$$\text{s.t.}$$

$$\pi_a \cdot (G_a - R) \geq 0 \qquad (\mathrm{IR}_a)$$

$$\pi_a \cdot (G_a - R) \geq \pi_b \cdot (G_b - R) \qquad (\mathrm{IC}_a)$$

Problem with moral hazard, bar a (II)

- Rewrite the constraint (simple algebra)

$$\max_{R} \quad \pi_a \cdot R - I$$

$$\text{s.t.}$$

$$R \leq G_a \qquad (\text{IR}_a)$$

$$R \leq \frac{\pi_a \cdot G_a - \pi_b \cdot G_b}{\pi_a - \pi_b} \qquad (\text{IC}_a)$$

Solution to the problem I

- We saw before that $R = G_a$ did not comply with (IC_a), which means that:

$$R \leq \frac{\pi_a \cdot G_a - \pi_b \cdot G_b}{\pi_a - \pi_b} < G_a$$

- We also conclude that (IC_a) must bind

- Note that in this case, IR_a will *not end up binding*!

- In other words, if the principal wants the agent to choose bar a, it means that the repayment must be so low that the agent will certainly say yes to the contract (intuition follows later)

Solution to the problem II

- We can find the optimal contract (R^a) directly from the (IC$_a$) constraint:

$$R^a = \frac{\pi_a \cdot G_a - \pi_b \cdot G_b}{\pi_a - \pi_b}$$

- We can easily verify that in comparison with the old contract...
  - ... the principal now receives a lower expected profit (there is an *information cost* to the principal)
  - ... the agent gets a positive expected profit (before, the agent got an expected profit of zero $\Longrightarrow$ there is an *information rent* to the agent)

Intuition

- If the agent is to choose bar a, the repayment (interest rate) must be lower
- Intuition 1: The old contract set the repayment such the bank got the full payoff if bar a succeeded
  - This implies that if the agent chooses bar a, this will give her a profit of zero even if successful.
  - Bar b bankrupt more often but gives higher payoff $\Rightarrow$ after repayment the agent gets positive profit if it succeeds $\Rightarrow$ incentive to gamble on b
- Intuition 2: Due to limited liability, the agent only ends up paying the repayment (including interest) if the project succeeds (bankruptcy = zero payment)
  - The more likely the project is to succeed, the greater the risk of having to repay
  - The greater the repayment (higher interest rate) selected, the more attractive the risky project, bar b, becomes

Socrative quiz question

True or false: Holding everything else equal, a higher probability of success of project A, π_A, will decrease the repayment R^a.

Credit Rationing Explanation

- The insight from this model has been used to explain credit rationing by Joseph Stiglitz (Nobel Prize 2001) and others.

- Although there is a shortage of loans, this cannot always be solved by raising interest rates. This is due to moral hazard: high interest rates can lead investors to opt for risky projects.

- The Sloth note reviews the point a little more thoroughly and formally (and, moreover, goes on to examine the contract if bar b is to be selected under moral hazard).

Competition and distribution I

- Distributively, Principal-Agent models tend to have the principal gain relatively much (remember, for example, the bar owner's profit of zero earlier)

- Reflects that the Principal-Agent model assumes a kind of monopoly: The Principal makes a take-it-or-leave-it offer, without competition

- This can generally be countered by increasing the reservation utility (or profit) assumed for the agent ($\bar{u}$) ...

- ... but one can actually more formally introduce competition by assuming that there are several Principals competing

Competition and distribution II

- Sketch of how to introduce (sharp) competition in a Principal-Agent framework:

  1. Assume there is a single principal and assume a given outside option of $\bar{u}$
  2. Solve for the optimal contract and the Principal's profit; these will be functions (depend) of the outside option: $R(\bar{u}), \pi(\bar{u})$
  3. The principal gets a positive profit $\Longrightarrow$ a competing principal enters the market and attracts the agent with a contract that gives a little more utility $\bar{u}' > \bar{u}$
  4. ... that kind of competition continues until the profit is zero ...
  5. In equilibrium, the agent's utility will be $\bar{u}^*$, which satisfies the equation $\pi(\bar{u}^*) = 0$; the contract negotiated in equilibrium is $R(\bar{u}^*)$

What have we learned?

- Moral hazard in loan markets can set a limit on how high interest rates lenders can ask for (can explain credit rationing)
- We have seen an example of a Principal-Agent problem where the Individual Rationality condition ends up not binding